Oct 28-29, 2011 – ATTREX Science Flight

Takeoff: 1736 UT, Landing: 1501 UT, Duration: 21:25

Overall, the flight was extremely successful. Early on, it appeared that the flight might be cut short by a communications problem. However, the flight planning team and pilots managed to design and execute an alternate flight plan that satisfied both our engineering and science objectives. Extended cold soaking of the aircraft and multiple profiles through the Tropical Tropopause Layer (TTL) were achieved.

The original flight plan had the aircraft heading southwest toward cold tropical air south of Hawaii. However, INMARSAT connectivity was lost when we switched to the Pacific satellite. (This was later determined to be a problem on the satellite provider side.) The aircraft was commanded back toward lost link until a solid link on INMARSAT was reestablished. The forecasting/flight planning team came up with an alternate flight plan that would permit sampling of cold tropical air in the eastern Pacific, and the pilots coordinated the necessary permissions for the new flight track. The Ku connection was lost when we headed south of about 9 N. The aircraft experienced unexpectedly low temperatures (down to about 192.5 K) at cruise altitude while heading south (see Figures 1and 2). The real-time MTP profile indicated this was a cold, high secondary tropopause. Vertical Profile Maneuvers (VPMs) were conducted to $\simeq$55 kft and 54 kft near the southern end of the track (about 6.6 N). Subsequent VPMs to 49, 48, and 48 kft were conducted between 9 and 11 N such that the Ku connection was maintained. The cold-point tropopause was about 192 K at about 54 kft, but there was considerable horizontal variability indicated by MTP and MMS (Figure 1). Despite the temperature variability, the ozone profile indicates a relatively compact distribution with height. The temperatures in the tropopause region were a few K colder than forecast. Preliminary water vapor measurements indicated very dry air ($H_2O < 4$ ppmv) near the tropopause. The minimum TT4 fuel temperature was about -35 F. With the low temperature fuel we were using, the yellow fault for fuel temperature was -39 F, and we had no problem on this flight. With the standard fuel, it is likely that we would have needed to cut the flight short and head north to avoid approaching the red fault.

On the return (northbound) leg, a double dip VPM was conducted, starting at about 17.5 N. The initial descent started above 60 kft, so the instruments were shut down. At about 57 kft, the pilot commanded an ascent such that we could restore power to the instruments. Instrument power-up was delayed a few minutes by an Iridium dropout. The pilot then proceeded with the double dip (down to 48 kft, up to 55 kft, down to 48 kft, back up to cruise altitude).

In general, the instruments worked well. ULH had some difficulty working at temperatures colder than -70 C where they seem to lose alignment. After the power off requirements for the descent from about 60 kft, mini-DOAS lost some data because of freezing switches. AWAS and CPL were not flown, but they should be back on the aircraft for the second flight.

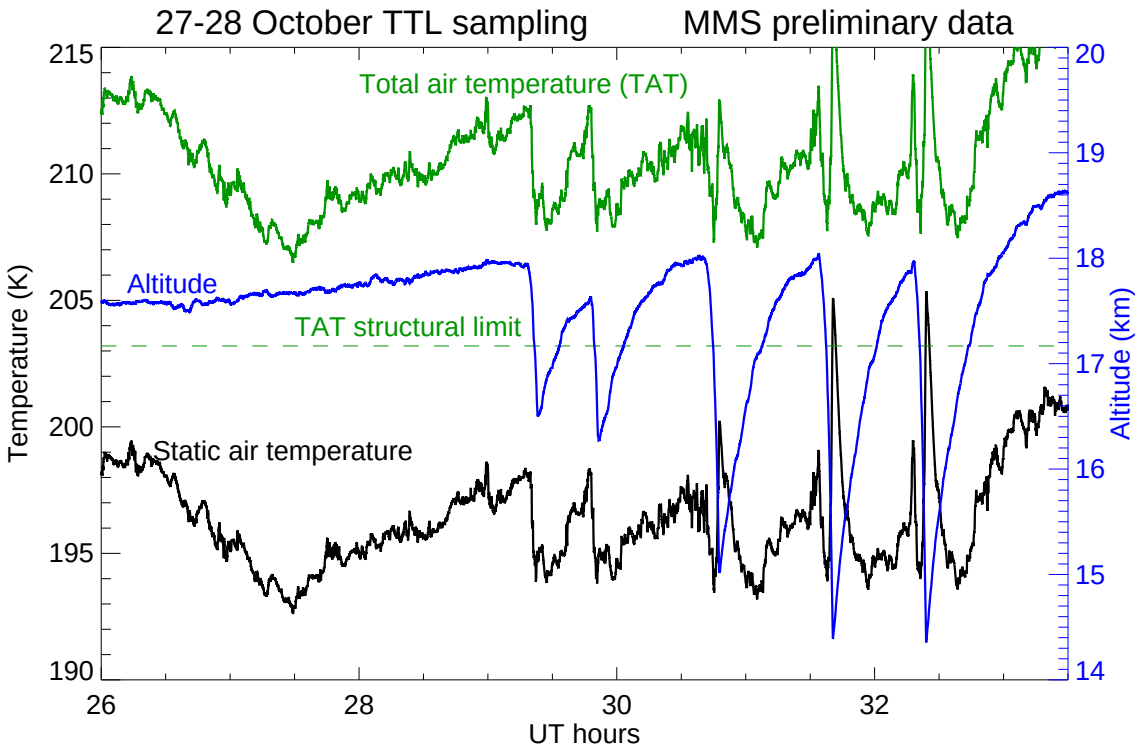

Figure 1: Time series of aircraft pressure altitude (blue), static air temperature (black), and total air temperature (green) covering the time period when the aircraft was executing VPMs in the tropics. Also shown is the structure total air temperature limit (green dashed).

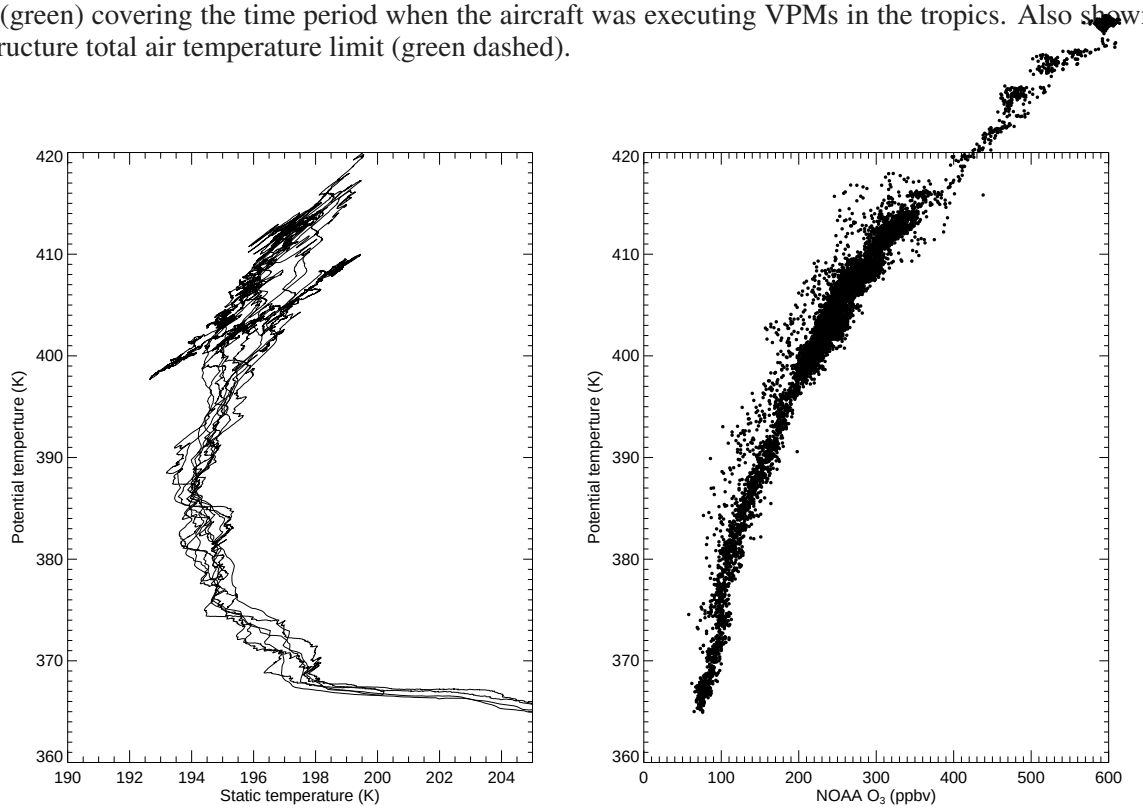

Figure 2: Vertical profiles of temperature (left panel, MMS) and ozone (right panel, NOAA) covering the time period shown in Figure 1 when the aircraft was profiling the TTL.